We claim:

1. A method of monitoring the condition of a substance in real time comprising:

(1) disposing an electrode mechanism in the substance;

(2) exciting said electrode mechanism sequentially with a specified number of alternating voltages, wherein each of the alternating voltages is at a different frequency in a range of frequencies;

(3) performing at least one calculation to generate at least one datum associated with each of the frequencies in the range of frequencies;

(4) creating a graph comprising x-values related to the specified number; and

(5) creating a combined plot by placing a plurality of plots generated from a plurality of spectra on the graph using the at least one datum associated with each of the frequencies in said range of frequencies.

2. The method of claim 1, further comprising repeating steps (1) – (5) at least once to place a plurality of combined plots on the graph.

3. The method of claim 2, further comprising building a spectral matrix that comprises at least two samples taken from the plurality of plots.

4. The method of claim 3, further comprising:

performing a Principal Component Analysis with respect to the spectral matrix;

analyzing the results of the Principal Component Analysis to identify at least one principal component having significant influence on the spectral matrix; and

creating a reduced spectral matrix having at least one column, wherein each column in the reduced spectral matrix is associated with a principal component having significant influence on the spectral matrix.

5. The method of claim 4, further comprising using a regression plot to analyze the results of the Principal Component Analysis.

6. The method of claim 4, further comprising applying a pre-processing function to the spectral matrix before performing a Principle Component Analysis on the spectral matrix.

7. The method of claim 4, further comprising building a result matrix comprising known quantities of a plurality of components in the substance.

8. The method of claim 7, further comprising performing a statistical technique that uses the reduced spectral matrix together with the result matrix to create at least one prediction equation for predicting properties in a second substance.

9. The method of claim 8, further comprising using the at least one prediction equation to predict at least one property in the second substance.

10. The method of claim 9, further comprising predicting the at least one property in the second substance in situ.

11. The method of claim 8, wherein the statistical technique is selected from the group consisting of Multivariate Least Squares Regression, Principle Component Regression, and Group Methods of Data Handling.

12. The method of claim 10, further comprising providing an end of life (EOL) indication for the substance when the amount of at least one of the at least one properties in the second substance has reached a predetermined value.

13. The method of claim 10, further comprising providing a remaining useful life (RUL) indication for the substance by comparing at least one of the at least one properties in the second substance to at least one baseline value for the substance.

14. A system for monitoring the condition of a substance in situ comprising:

an electrode mechanism that is operational when disposed in the substance;

a mechanism for exciting the electrode mechanism sequentially with a specified number of alternating voltages; and

a computing device for performing at least one calculation to generate at least one datum associated with each of a plurality of frequencies in the range of frequencies, wherein the computing device is capable of receiving input from the electrode mechanism.

15. The system of claim 14, further comprising a current sensor, wherein the computing device is configured to receive input from the current sensor.

16. The system of claim 14, wherein the at least one datum includes at least one value for resistive impedance and at least one value for reactive impedance.

17. The system of claim 14, further comprising an information library.

18. The system of claim 17, wherein the computing device comprises the information library.

19. The system of claim 17, wherein the information library comprises at least one prediction equation.

20. The system of claim 19, wherein the at least one prediction equation comprises at least one coefficient generated by using a statistical technique that uses a result matrix together with at least one reduced spectral matrix.

21. The system of claim 19, wherein the at least one prediction equation comprises at least one coefficient generated by combining:

at least one first interim coefficient generated by using a statistical technique that uses a result matrix together with a first reduced spectral matrix; and

at least one second interim coefficient generated by using a statistical technique that uses a result matrix together with a second reduced spectral matrix;

22. The system of claim 20, wherein the at least one reduced spectral matrix comprises data from at least one Bode plot of resistive impedance and at least one Bode plot of reactive impedance.

23. The system of claim 20, wherein the at least one reduced spectral matrix comprises data from at least one Nyquist plot.

24. The system of claim 20, wherein the at least one reduced spectral matrix is a combined reduced spectral matrix.

25. The system of claim 19, wherein the computing device further comprises at least one predicted property value generated using the at least one prediction equation.

26. The system of claim 25, wherein the information library further comprises at least one baseline value.

27. The system of claim 26, wherein the computing device further comprises at least one property prediction that is generated using the at least one predicted property value and the at least one baseline value.

28. The system of claim 27, wherein the computing device is configured to output a remaining useful life (RUL) indication.

29. The system of claim 27, wherein the computing device is configured to output an end of life (EOL) indication.

30. A method for monitoring the condition of a substance in situ comprising:

disposing in the substance an electrode mechanism that is operational when disposed in the substance;

exciting the electrode mechanism sequentially with a specified number of alternating voltages; and

performing at least one calculation to generate at least one datum associated with each of a plurality of frequencies in the range of frequencies.

31. The method of claim 30, wherein the at least one datum includes at least one value for resistive impedance and at least one value for reactive impedance.

32. The method of claim 30, further comprising creating an information library.

33. The method of claim 32, wherein the information library comprises at least one prediction equation.

34. The method of claim 33, wherein the at least one prediction equation comprises at least one coefficient generated by using a statistical technique that uses a result matrix together with at least one reduced spectral matrix.

35. The method of claim 33, wherein the at least one prediction equation comprises at least one coefficient generated by combining:

at least one first interim coefficient generated by using a statistical technique that uses a result matrix together with a first reduced spectral matrix; and

at least one second interim coefficient generated by using a statistical technique that uses a result matrix together with a second reduced spectral matrix;

36. The method of claim 35, wherein the at least one reduced spectral matrix comprises data from at least one Bode plot of resistive impedance and at least one Bode plot of reactive impedance.

37. The method of claim 35, wherein the at least one reduced spectral matrix comprises data from at least one Nyquist plot.

38. The method of claim 35, wherein the at least one reduced spectral matrix is a combined reduced spectral matrix.

39. The method of claim 33, further comprising generating at least one predicted property value using the at least one prediction equation.

40. The method of claim 39, wherein the information library further comprises at least one baseline value.

41. The method of claim 40, further comprising generating at least one property prediction using the at least one predicted property value and the at least one baseline value.

42. The method of claim 41, further comprising generating a remaining useful life (RUL) indication.

43. The method of claim 41, further comprising generating an end of life (EOL) indication.

44. A system for developing an information library for use in monitoring the condition of a substance in situ comprising:

an electrode mechanism operational when disposed in a first substance;

a mechanism for exciting said electrode mechanism sequentially with a specified number of alternating voltages, wherein each of the alternating voltages is at a different frequency in a range of frequencies; and

a computing device for performing at least one calculation to generate at least one datum associated with each of the frequencies in the range of frequencies.

45. The system of claim 44, wherein the at least one datum includes at least one value for resistive impedance and at least one value for reactive impedance.

46. The system of claim 44, wherein the computing device is configured to receive as input a measurement of the current in the electrode mechanism at each of the frequencies in the range of frequencies.

47. The system of claim 44, wherein the range of frequencies is between approximately 75 kilohertz and 0.0075 hertz.

48. The system of claim 44, further comprising the computing device configured to create a graph comprising (1) at least one x-value related to the specified number and (2) a combined plot, wherein the data used to create the combined plot comprises the at least one datum associated with each of the frequencies in said range of frequencies.

49. The system of claim 48, wherein the data used to create the combined plot further comprises:

at least one datum from a first spectra comprising the at least one datum associated with each of the frequencies in said range of frequencies; and

at least one datum from a second spectra comprising the at least one datum associated with each of the frequencies in said range of frequencies;

wherein each of the at least one datum from the first spectra and the at least one datum from the second spectra are associated with one of the at least one x-values.

50. The system of claim 49, wherein the first spectra comprises determined values for resistive impedance and the second spectra comprises determined values for reactive impedance.

51. The system of claim 48, wherein the data used to create the combined plot further comprises at least one datum derived from a Nyquist plot and the at least one datum derived from a Nyquist plot is associated with the at least one x-value.

52. The system of claim 51, wherein the at least one datum derived from a Nyquist plot includes at least one datum from the bulk region of the Nyquist plot and at least one datum from the interfacial region of the Nyquist plot. .

53. The system of claim 48, wherein the graph further comprises a plurality of combined plots.

54. The system of claim 53, further comprising a spectral matrix that comprises at least two samples taken from the plurality of combined plots.

55. The system of claim 53, wherein the plot of the determined values for resistive impedance and the plot of the determined values for reactive impedance are Bode plots.

56. The system of claim 54, further comprising the computing device configured to perform a Principal Component Analysis with respect to the spectral matrix.

57. The system of claim 56, further comprising the computing device configured to use the results of the Principal Component Analysis to create a reduced spectral matrix with at least one column.

58. The system of claim 57, further comprising a regression plot that is used to analyze the results of the Principal Component Analysis.

59. The system of claim 57, further comprising a pre-processing function that is applied to the spectral matrix before performing a Principle Component Analysis on the spectral matrix.

60. The system of claim 57, further comprising a result matrix comprising known quantities of a plurality of components in the substance.

61. The system of claim 60, further comprising the computing device configured to perform a statistical technique that uses the reduced spectral matrix together with the result matrix to create at least one prediction equation for predicting properties in a second substance.

62. The system of claim 61, further comprising configuring the computing device to use the at least one prediction equation to predict at least one property in the second substance.

63. The system of claim 61, wherein the statistical technique is selected from the group consisting of Multivariate Least Squares Regression, Principle Component Regression, and Group Methods of Data Handling.

64. A method of creating an information library comprising information about a substance, comprising the steps of:

(1) generating a plurality of first plots of spectra over a range of frequencies; and

(2) creating a second plot that comprises the plurality of first plots by sequentially assigning x-values to selected frequencies in the plurality of first plots.

65. The method of claim 64, further comprising:

(3) repeating steps (1) – (2) at least once to generate a plurality of second plots.

66. The method of claim 65, further comprising building a spectral matrix that comprises data taken from the plurality of second plots.

67. The method of claim 65, wherein the plurality of first plots comprises at least one Bode plot.

68. The method of claim 65, wherein at least one of the plurality of first plots comprises at least one datum derived from a Nyquist plot.

69. The method of claim 68, wherein the at least one datum derived from a Nyquist plot includes at least one datum from the bulk region of the Nyquist plot and at least one datum from the interfacial region of the Nyquist plot.

70. The method of claim 66, wherein at least one of the plurality of first plots is a plot of resistive impedance spectra.

71. The method of claim 70, wherein at least one of the plurality of first plots is a plot of reactive impedance spectra.

72. The method of claim 64, wherein the range of frequencies is between approximately 75 kilohertz and 0.0075 hertz.

73. The method of claim 66, further comprising performing a Principal Component Analysis on the spectral matrix.

74. The method of claim 73, further comprising using the results of the Principal Component Analysis to create a reduced spectral matrix having at least one column.

75. The method of claim 74, further comprising using a regression plot to analyze the results of the Principal Component Analysis.

76. The method of claim 74, further comprising applying a pre-processing function to the spectral matrix before performing a Principle Component Analysis on the spectral matrix.

77. The method of claim 74, further comprising building a result matrix comprising known quantities of a plurality of components in the substance.

78. The method of claim 77, further comprising performing a statistical technique that uses the reduced spectral matrix together with the result matrix to create at least one prediction equation.

79. The method of claim 78, further comprising using the at least one prediction equation to predict at least one property in a second substance.

80. The method of claim 79, further comprising predicting the at least one property in the second substance in situ.

81. The method of claim 79, further comprising providing an end of life (EOL) indication for the second substance when the amount of at least one of the at least one properties in the second substance has reached a predetermined value.

82. The method of claim 79, further comprising providing a remaining useful life (RUL) indication for the second substance by comparing at least one of the at least one properties in the second substance to at least one baseline value for the substance.

83. The method of claim 78, wherein the statistical technique is selected from the group consisting of Multivariate Least Squares Regression, Principle Component Regression, and Group Methods of Data Handling.

84. A method of analyzing a substance, comprising the steps of:

(1) generating a plurality of first plots of spectra over a range of frequencies;

(2) generating a plurality of second plots of spectra over the range of frequencies;

(3) repeating steps (1) – (2) at least once to generate a plurality of first plots and a plurality of second plots; and

(4) creating a first spectral matrix from the plurality of first plots and a second spectral matrix from the plurality of second plots.

85. The method of claim 84, wherein each of the first plots is a plot of resistive impedance spectra and each of the second plots is a plot of reactive impedance spectra.

86. The method of claim 84, further comprising performing a first Principal Component Analysis on the first spectral matrix and a second Principal Component Analysis on the second spectral matrix.

87. The method of claim 86, further comprising:

using the results of the first Principal Component Analysis to create a first reduced spectral matrix having at least one column; and

using the results of the second Principal Component Analysis to create a second reduced spectral matrix having at least one column.

88. The method of claim 87, further comprising using a regression plot to analyze the results of the first Principal Component Analysis.

89. The method of claim 87, further comprising using a regression plot to analyze the results of the second Principal Component Analysis.

90. The method of claim 87, further comprising applying a pre-processing function to the first spectral matrix before performing the first Principle Component Analysis on the first spectral matrix.

91. The method of claim 87, further comprising applying a pre-processing function to the second spectral matrix before performing the first Principle Component Analysis on the second spectral matrix.

92. The method of claim 87, further comprising building a result matrix comprising known quantities of a plurality of components in the substance.

93. The method of claim 87, further comprising:

performing a statistical technique that uses the first reduced spectral matrix together with the result matrix to create at least one first prediction equation; and

performing the statistical technique using the second reduced spectral matrix together with the result matrix to create at least one second prediction equation.

94. The method of claim 93, further comprising:

using at least one first prediction equation to determine at least one first predicted value relating to at least one property in a second substance;

using at least one second prediction equation to determine at least one second predicted value relating the to at least one property in the second substance; and

combining the at least one first predicted value and at least one second predicted value to predict the least one property in the second substance.

95. The method of claim 94, further comprising predicting the at least one property in the second substance in situ.

96. The method of claim 95, further comprising providing an end of life (EOL) indication for the second substance when the amount of at least one of the at least one properties in the second substance has reached a predetermined value.

97. The method of claim 95, further comprising providing a remaining useful life (RUL) indication for the second substance by comparing at least one of the at least one properties in the second substance to at least one baseline value for the substance.

98. The method of claim 93, wherein the statistical technique selected from the group consisting of Multivariate Least Squares Regression, and Group Methods of Data Handling.

99. The method of claim 87, further comprising building a combined reduced spectral matrix by combining the first reduced spectral matrix and the second reduced spectral matrix.

100. The method of claim 99, further comprising adding data derived from a Nyquist plot to the combined reduced spectral matrix.

101. The method of claim 100, wherein the data derived from a Nyquist plot includes at least one datum from the bulk region of the Nyquist plot and at least one datum from the interfacial region of the Nyquist plot.

102. The method of claim 99, further comprising performing a statistical technique that uses the combined reduced spectral matrix and the result matrix to create at least one prediction equation.

103. The method of claim 102, further comprising using the at least one prediction equation to predict at least one property in a second substance.

104. The method of claim 103, further comprising predicting the at least one property in the second substance in situ.

105. The method of claim 104, further comprising providing an end of life (EOL) indication for the second substance when the amount of at least one of the at least one properties in the second substance has reached a predetermined value.

106. The method of claim 104, further comprising providing a remaining useful life (RUL) indication for the second substance by comparing at least one of the at least one properties in the second substance to at least one baseline value for the substance.

107. The method of claim 102, wherein the statistical technique is selected from the group consisting of Multivariate Least Squares Regression, Principle Component Regression, and Group Methods of Data Handling.

108. A method of analyzing a substance, comprising the steps of:

(1) generating a plurality of Nyquist plots, wherein each Nyquist plot is associated with a sample of the substance;

(2) creating derived data by deriving at least one datum from each of the Nyquist plots; and

(3) populating a spectral matrix with the derived data.

109. The method of claim 108, wherein the derived data includes at least one datum from the bulk region of the Nyquist plot and at least one datum from the interfacial region of the Nyquist plot.

110. The method of claim 108, wherein the derived data includes at least one of: a resistive impedance value where reactive impedance is minimum, a reactive impedance value where reactive impedance is minimum, a frequency at which reactive impedance is minimum, a maximum resistive impedance value within the total data set, a minimum resistive impedance value within the total data set, a resistive impedance value for the centerpoint of the circle in the bulk region of the Nyquist spectrum, a reactive impedance value for the centerpoint of the centerpoint of the bulk circle, a measurement in radians of the angle between the x axis and a line drawn through the origin of the graph and the centerpoint of the bulk circle, a calculation of the radius of the bulk circle, a resistive impedance value for the centerpoint of the circle in the interfacial region of the Nyquist spectrum, a reactive impedance value for the centerpoint of the interface circle, a measurement in radians of the angle between the x axis and a line drawn through the origin of the graph and the centerpoint of the interface circle, and a calculation of the radius of the interface circle.

111. The method of claim 108, further comprising performing a Principal Component Analysis on the spectral matrix.

112. The method of claim 111, further comprising:

analyzing the results of the Principal Component Analysis to identify at least one principal component having significant influence on the spectral matrix; and

creating a reduced spectral matrix having at least one column, wherein each column in the reduced spectral matrix is associated with a principal component having significant influence on the spectral matrix.

113. The method of claim 112, further comprising applying a pre-processing function to the spectral matrix before performing a Principle Component Analysis on the spectral matrix.

114. The method of claim 112, further comprising building a result matrix comprising known quantities of a plurality of components in the substance.

115. The method of claim 114, further comprising performing a statistical technique that uses the reduced spectral matrix together with the result matrix to create at least one prediction equation.

116. The method of claim 115, further comprising using the at least one prediction equation to predict at least one property in a second substance.

117. The method of claim 116, further comprising predicting the at least one property in the second substance in situ.

118. The method of claim 117, further comprising providing an end of life (EOL) indication for the second substance when the amount of at least one of the at least one properties in the second substance has reached a predetermined value.

119. The method of claim 117, further comprising providing a remaining useful life (RUL) indication for the second substance by comparing at least one of the at least one properties in the second substance to at least one baseline value for the substance.

120. The method of claim 115, wherein the statistical technique is selected from the group consisting of Multivariate Least Squares Regression, Principle Component Regression, and Group Methods of Data Handling.